REPORT OF

The Lancet Special Commission

ON

BATH AS A HEALTH RESORT.

Introduction.

The department of medical science known as "balneology and hydro-therapeutics" has been especially studied during the past few years, but our knowledge of the action of the natural mineral waters, whether taken internally or administered externally, is still vague and the treatment adopted at the numerous spas must be designated as empirical. Experience has conclusively shown, however, that both methods of employing the "waters" are of great value in the treatment of certain diseases. What may be said to be the necessary conditions for the satisfactory and successful establishment of a spa? First, and most obviously, a plentiful supply of a water possessing actual therapeutic properties, dependent either on its temperature or on its mineral or gaseous constituents; secondly, the erection of suitable apparatus and appliances for the use of the water for medicinal purposes; thirdly, satisfactory hygienic surroundings; fourthly, the supervision of the patients by medical men who have made a special study of the properties of the local spring or springs; fifthly, a full staff of carefully trained attendants; and sixthly, social attractions. How far does Bath fulfil these requirements? We need not here consider the third heading; the sanitary condition of Bath is reported upon by our Sanitary Commissioner. A criticism of the medical faculty of Bath would also be out of place; suffice it to say that a number of the resident practitioners have made hydro-therapeutics a special study for many years and have thus constituted themselves experts on the medicinal use of the waters.

The Supply of Water.

To commence, then, with the first postulate named above—a plentiful supply of a water possessing therapeutic properties. The constituents of the water are described in another column, but it is impossible merely from the chemical analysis of a mineral water to give an absolute judgment as to what its clinical value is likely to be. There are some who maintain that the results of the treatment of disease by the Bath waters are simply dependent on their temperature and that the same results could be obtained by the use of ordinary water heated to the same temperature. Even granting that to be the case it would not displace Bath as a health resort, for it would practically be impossible to obtain an equal supply of water at a uniform temperature of from 104° to 120° F., as is here provided by nature. The total volume of water issuing from all the springs exceeds 500,000 gallons a day. The general opinion is, however, that the above view is not the correct one and that the constituents of the water do play an important though undetermined part in its medicinal value. This statement does not apply so much to the mineral salts which it contains as to the gaseous constituents. Reference to the analytical report will show that there is a large quantity of nitrogen evolved, together with some carbonic acid, oxygen, and the two rare elements, helion and argon. Our knowledge of the action of these gases on the human organism is small, but there would seem to be but little doubt that they do exert considerable power, whether by mechanical action on the peripheral nerve-endings and cutaneous vessels or by absorption is uncertain. The mineral constituents are not absorbed—at least, to any appreciable extent—but whether or not the gases are absorbed is another question. Attempts have been made to imitate the constitution of natural mineral waters but without success. Dr. Luff has made analogous experiments with regard to the ashes of plants and has shown that, although the extracts of the ashes have a solvent effect on the biurate of soda, when an attempt is made to form the solution artificially the same solvent action is not obtained. So is it probably with efforts to imitate the natural waters, the explanation being that it is not known what is the natural combination in which the elements exist and clinically that fact may make all the difference. It has been suggested that "telluric" heat may differ from artificial heat, but this supposition has by no means been proved.

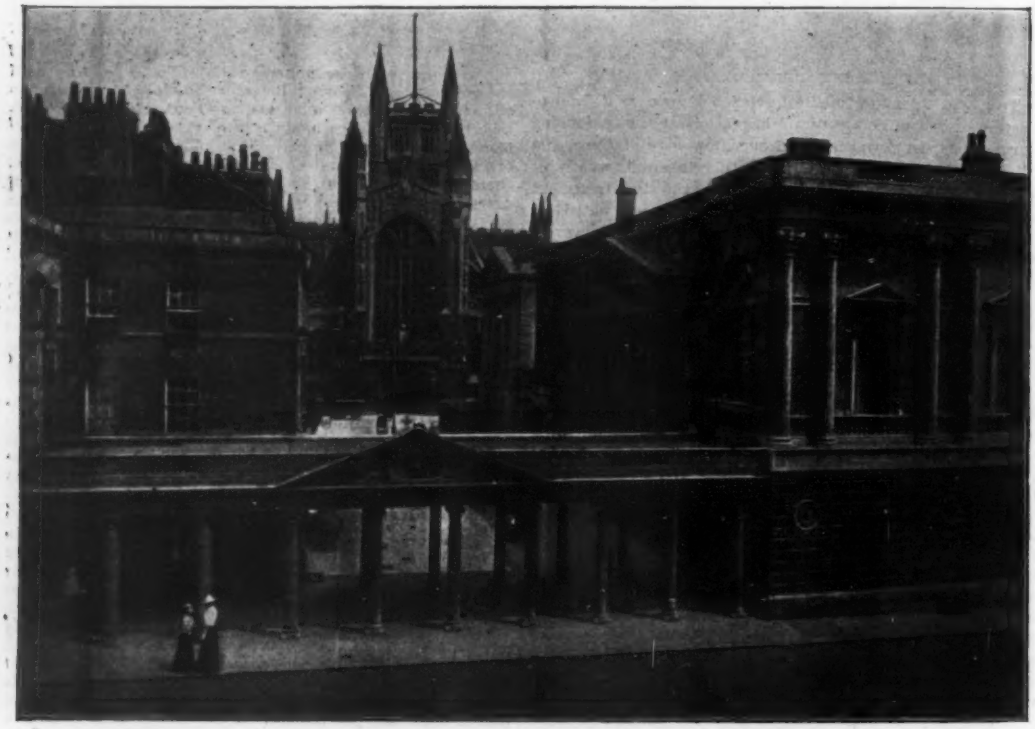
The thermal waters of Bath rise by three springs, known respectively as "The Hot Spring or Old Royal Bath," "The King's Bath Spring," and "The Cross Bath Spring." Their composition and temperatures are given in our analytical report. The Cross Bath Spring may be dispensed with in a few words, as it is solely employed to supply a swimming bath, the charge for admittance to which is only 1*d*., and when other attractions are absent this bath is extensively patronised by the young people of the neighbourhood. The flow of water is estimated at half a hogshead per minute. When the bath is filled to a depth of four and a half feet it contains 11,350 gallons; the temperature is then generally between 84° and 90°. For "drinking" purposes the water from the King's Bath Spring is used, being pumped up at a temperature of 114°. It is drawn from a many-sprayed fountain in the Grand Pump Room (see Fig. 1) which receives a supply of eight and a half gallons per minute. A circular marble basin surrounds the fountain and receives the overflow in which the glasses for the water stand so that they are kept constantly warm. It is interesting to observe the change of colour which takes place in the glass owing to the presence of iron in the water. If deemed necessary the water can be heated to 150° by artificial means without any admixture or interference with its inherent properties, and it is so administered at the "Hetling Pump Room." The water for the baths (see analytical report) is forced by means of two pumps into a huge closed tank capable of holding 20,000 gallons. The pumps are each capable of dealing with that amount of water per hour, so that a plentiful supply is assured under considerable pressure. As regards the first

qualification for a spa Bath can successfully hold its own against any medical resort in Europe.

APPARATUS AND APPLIANCES.

Equally important is the second point—suitable apparatus and appliances. In this respect, also, Bath is to be highly complimented. The city has a great advantage over most similar continental resorts—namely, that the administration of the baths is vested in the hands of the city corporation and not in the hands of the Government. Under a governmental *régime* the appliances as a rule are marked by great and often inconvenient simplicity. At Bath, on the other hand, the managing body spares no expense to make the baths and the surroundings not only as complete as possible, but even luxurious; everything that can add to the comfort of the bathers is provided. Not only so, but every new therapeutical appliance which promises to be of use in treatment is at once installed should it be recommended by the advisory committee which is composed of medical men.

FIG. 1.



View of the Grand Pump Room.

A large variety of baths are in use, some of the appliances having been adopted from other spas, but only those most commonly employed will be considered in this report.

The deep or chair bath.—The rooms in which the baths are contained are from 12 feet to 14 feet long, eight feet wide, and 11 feet high. Each bath occupies the greater part of a room; it is T-shaped and lined throughout with porcelain tiles, giving a very pleasing appearance. Each bath contains from 800 to 900 gallons of water, with an average depth of about four feet six inches. It is large enough to enable the patient to move freely about and brass rings for the patient to hold on to are fixed in the walls. There are marble seats attached to the sides of the bath. The approach is by a flight of steps with brass rails on either side. Whilst in the bath the patient is almost entirely submerged (see Fig. 2). An excellent device is adopted for those patients who owing to physical causes are unable to walk down the steps; a wooden arm-chair is suspended from a metal rail which runs across the room. By means of pulleys the chair can be brought to the door of the dressing-room, the patient placed in it, and if thought desirable he can be held in it by means of a sheet, but as a rule this is not necessary. The chair is pulled over the bath and by hydraulic power gently lowered into the bath. The movement is wonderfully even and easily controlled, contrasting very favourably with the awkward apparatus adopted at some other spas. After a few baths it is often possible for the patient to get out of the chair whilst in the bath and, supported by the water and holding on to the rings, he can gradually begin to move the limbs. A special feature of these baths is the "under-current douche." This consists of a hose and nozzle a powerful stream from which can be applied to any part of the patient's body whilst under water. This has been found most valuable in the treatment of sciatica. The temperature of the bath can be maintained by the natural heat of the waters at 110°, but if this is considered too hot it is cooled by means of cold mineral water to the required temperature. The composition of the water is thus not altered. The temperature and force of the douche can also be accurately regulated, the water passing through a "mixer" before reaching the hose. After each bath the room is thoroughly cooled and ventilated. The dressing-rooms are admirably appointed and every requisite for the invalid's comfort is supplied. In the New Royal private baths each dressing-room has a water-closet attached to it. The greatest attention is of course given to cleanliness.

The reclining baths.—These are used at the different establishments if preferred to the deep baths, some patients being unable to take advantage of the latter. Each contains about 150 gallons of water and is provided with a hose and nozzle, so that the under-current douche can be applied. The arrangements for regulating the temperature are the same as in the deep bath. Massage is sometimes employed in connexion with these baths.

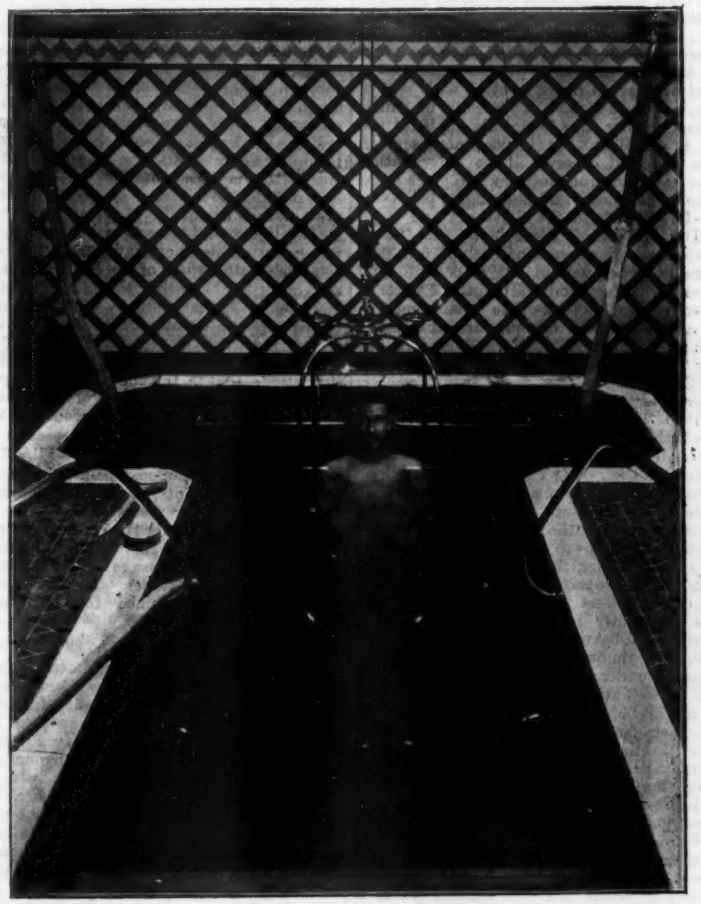
Aix massage douche baths (see Fig. 3).—These have

been adopted from Aix-les-Bains. The rooms set apart for this process are admirably arranged; each douche-room has two or three dressing-rooms so that a large number of patients can be attended to without any unnecessary waiting. The douche-rooms measure 13 feet 9 inches by 10 feet 6 inches, with domed roofs 20 feet high. The walls and roof are tiled throughout. The floors are artistically laid in ceramic tesserae. Douche, sprays, and showers of many varieties are arranged round the walls and there is a double water-supply to each consisting of hot and cold natural water so that the temperature can be accurately regulated. The furniture of the room consists of a wooden chair and stool, both of which are sprayed with hot water before use. Whilst the bath is proceeding the floor is covered with a layer of water four inches deep, the excess constantly escaping through one corner into the Roman culvert. If two attendants are present each douches the patient with water at the stipulated temperature whilst applying massage. If one masseur only is employed a stream of water is passed through a large rose and plays over the back or chest of the patient whilst one or other is receiving the rubbing by the attendant. The time of the bath can be judged by a sand-glass fixed to the wall of the room. Towards the end of the bath the temperature is gradually lowered and finally the patient has a cool shower or needle-bath. He then returns to the dressing-room, where he is "packed" by the attendant and is gradually allowed to cool, completing the process in one of the comfortable rooms, well supplied with literature, which are provided for the purpose.

Needle-bath.—This apparatus (see Fig. 3) has six ribs on solid brass supports, with perforations in each rib $1\frac{1}{2}$ inches apart, which are so fine that with a two-inch service pipe fine jets of water cover an area of 3 feet 6 inches. By this means the whole of the patient's body receives the spray at the same time, producing a markedly bracing effect.

The local spray (see Fig. 4), which is known at Bath as a "dry douche," distinguishing it from the "wet douche" when the patient is immersed in the bath, is employed when it is undesirable to bathe the patient. The apparatus is so arranged that a strong current of water at a temperature of 115° is sprayed over an arm or leg through a rose, the rest of the body being protected and kept dry; in fact, the individual operated on does not undress. A great advantage is that the heat of the water being a natural heat there is no fear of the temperature being too high. This method is found useful in some chronic joint affections.

FIG. 2.



The "Deep" or "Chair" Bath.

The Scottish douche.—This is used in the same room as the douche-massage and consists of two hoses and nozzles by means of which strong streams of hot and cold water can be alternately turned on to the patient. It is useful in cases of neurasthenia.

Sitz-bath.—This is a very remarkable apparatus; it can be used as a lumbar spray or spinal bath, or as an enema bath, or as a vaginal douche, sprays or streams of

water playing in the desired direction according to the tap which is turned.

The Berthollet or natural vapour bath may be local or general. By means of an ingenious apparatus any part of the body—a leg, an arm, or a single joint—can be submitted to the influence of the steam derived from the thermal waters. The temperature can be raised by admixture of ordinary steam, but the usual temperature is 110°. This appliance is frequently adopted in cases of acute gout; the pain is not only relieved but the attack is shortened. In the same room is the general vapour bath, consisting of a wooden box with a round hole in its moveable lid, so that the patient is entirely shut in with the exception of his head. The hot vapour rises about him and he soon begins to perspire freely. Some of the subacute and chronic forms of eczema, in which bathing is forbidden, are treated by the natural vapour with admirable results; and the same may be said as to cases of lichen, acne, psoriasis, and senile prurigo. In the last-named the intense irritation is often markedly relieved.

Medicated baths are sometimes employed, such as pine, sulphur, pumiline, &c., the necessary ingredients being added to the thermal waters. A room is fitted with sprays for the throat, eyes, ears, and nose, by means of which atomised and pulverised vapour may be locally applied; the apparatus employed is excellent, but it does not seem to receive the attention which it deserves. The pulverisation process is found to be useful in bronchorrhœa and gives relief also in diseases of the throat, nose, and pharyngeal passages.

Swimming baths.—In addition to the above are two large swimming-baths. The largest of these is at the "New Royal." It is a handsome and convenient bath of fine proportions and admirably appointed in all respects. The dimensions are 80 feet by 35 feet and the depth of water is graduated from three feet to five feet. The usual temperature maintained by admixture with cooled mineral water is 84°. When filled this bath contains 40,000 gallons. At the Old Royal is another fine bath, 62 feet by 23 feet and 4½ feet deep and containing 37,225 gallons.

Thermalsoolbäder or the "Nauheim Baths."—To the appliances hitherto described the highest praise can be accorded and it is doubtful whether at any spa such a complete and well-appointed bathing establishment can be found. Bath waters have a just fame of their own, but it is very questionable whether they can artificially be made to resemble those found at other health resorts any more than those peculiar to other spas can be made to equal the Bath thermal waters. Apparatus and appliances can be copied, but, as stated at the commencement of this report, the therapeutic effects of natural waters depend upon properties not yet fully understood—namely, the combinations in which the ingredients are held, and it is practically impossible successfully to imitate them. Those who have seen the water entering the baths at Nauheim know the force with which it does so; the gas is under an immense pressure and the temperature of the water is from 89° to 95°. By artificial means it would be difficult to aerate water at a higher temperature than 60° except under pressure. Two plans have been tried at Bath and all due praise must be given to the Bath authorities for the efforts they have made; but—and in this opinion the great majority of the local physicians agree—the result has not been satisfactory, and after due trial these gentlemen report that equally good results are obtained from the natural thermal water as are produced by the artificial baths.

One method adopted is as follows. An elaborate plant has been erected by means of which the cold natural water is aerated by carbonic acid at a considerable pressure. An ordinary reclining bath is employed, round the foot of which (at the bottom of the bath) and along the sides for about three-quarters of its length runs a perforated pipe through which is forced at varying pressures the aerated water. At the foot of the bath is the pipe through which the hot water enters. The bath holds 150 gallons and the temperature of the water is usually 95°. 14 pounds of common salt are added and from one to two pints of Nauheim "Mutterlauge." The patient enters the bath and lies down and after a few minutes the aerated water is allowed to enter. The ebullition is very free, so much so that it is deemed desirable that a spray of warm water should play just in front of the patient's face to prevent him from inhaling too much carbonic acid. At Nauheim no such procedure is adopted and no inconvenience is experienced. Although cold water is constantly entering at the foot and sides of the bath, yet owing to the spray and to hot water entering at the foot of the bath the thermometer floating in the bath keeps fairly steady at 95°, but the person in the bath feels distinctly the entrance of the cold water. The sensation is not disagreeable, but an equable temperature is of great importance. Again, the gas is only applied to the lower half of the body and in a very unsatisfactory manner, and the peculiar effect produced on the skin by the adhesion of minute bubbles of gas to the fine hairs of the body by immersion in the true Nauheim water takes place to an exceedingly limited extent. The effect of the bath is decidedly invigorating, but the pulse is scarcely affected—the volume becomes slightly fuller, as happens in any warm bath, but there is no marked slowing such as is experienced at Nauheim. The bath might be occasionally used to vary the ordinary Bath treatment, but it is very doubtful whether it can be said to have any specific effect on the heart.

The second method adopted to try to imitate the Nauheim waters is to add to the thermal water some chloride of calcium and then to place Sandow's tablets at the bottom of the bath. Considerable effervescence occurs and the bubbles of gas are finer and more uniformly distributed throughout the bath than in the first method described, but again the characteristic effects of the Nauheim baths are not observed. An improvement in the cardiac condition in patients undergoing treatment by the ordinary bath methods is undoubtedly constantly observed, but after careful observation the majority of the medical men engaged in the spa practice are firmly of opinion that no better results are obtained by the use of the artificial Nauheim baths. The corporation would therefore be well advised in the praiseworthy attempts they have made and are still making to establish Bath as one of the leading spas, if not the leading spa of the world, by the installation of every kind of mechanical appliance likely to benefit the patients, but not to attempt to imitate other natural waters—failure will almost inevitably result.

We may here draw attention to another important consideration—that is, the convenience of approach to the baths. Patients can reside close to or at some distance from the baths as their fancy or the needs of their condition may direct.

STAFF OF ATTENDANTS.

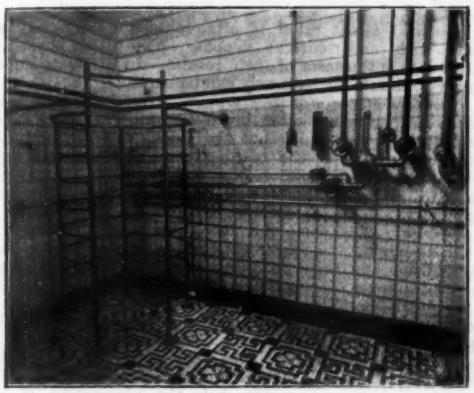
Turning now to the next point, the necessity of a full staff of trained attendants, in this respect again Bath is second to no other similar resort. The staff numbers altogether about 50 persons, under the control of a most capable general manager. There are several male and female attendants who are skilled in massage and who are most assiduous in their care of the bathers. The arrangements by which the appointments are booked for the patients prevent any confusion or delay.

SOCIAL ATTRACTIONS.

The need of increased social attractions is, it will be seen, insisted on by our Sanitary Commissioner and we must endorse his views. The necessity for such attractions is of more importance than may at first sight appear. One explanation of the success of spa treatment is the complete change in the patients' surroundings and the strict diet and general *régime* under which they are placed. Patients are willing to do at a health resort what they will not submit to at their own homes and this control certainly plays a very prominent part in hydro-therapeutics. But in order that this element may be brought into action some considerable social attractions are absolutely necessary. When the novelty of the treatment has passed off the patients will need other allurements to occupy their minds. At all continental resorts music is provided in ample quantity and of good quality. It is advantageous, of course, that the amusement should be as much as possible in the open air, but our climate will not always permit this. The open-air café is not sufficiently established in this country, but the beautiful parks about Bath offer excellent facilities for such arrangements and it is a pity that more advantage is not taken of the situation. As far as we could ascertain refreshments can only be obtained in the open air in one of the parks. On the other hand, amusement is provided by means of excellent military bands, floral fetes, children's carnivals, gymkhanas, &c., not to mention the renowned rose show. The band which formerly played in the grand pump-room has now been transferred to the handsome new concert-room and plays there twice daily, and evening concerts are given three times

weekly from October to May. The majority of the visitors would probably more appreciate the room if instead of the seats being arranged in rows, as in an ordinary concert-room, so lending an appearance of stiffness to the assembly, they were placed on the continental plan around small tables. The other new buildings are also a great and needed addition to the bathing establishments. These comprise a new promenade with its subsidiary rooms and certain additions to the old Roman bath. The promenade round the latter looks cold and uninviting. On certain occasions it is illuminated and makes a pleasant lounge. During the warmer months it would be an improvement if tables and chairs were always placed there interspersed with shrubs and flowering plants

FIG. 3.



Room for Aix massage and needle spray.

and arrangements made for the supply of simple refreshments so that invalids might get a little respite from their introspective studies by watching an animated scene. Other rooms in connexion with the promenade are the ladies' parlour, the gentlemen's smoking-room, the cloak-room, and the attendants' room.

On reviewing all that has been said above the conclusion must undoubtedly be arrived at that Bath possesses in a most satisfactory manner all the requirements of a valuable resort for the treatment of disease by hydro-therapeutic measures. There is no real reason why patients suffering from diseases presently to be enumerated should take the long journey to the continental spas when equally good results can be obtained at Bath. In addition, by not leaving their own country they will enjoy their accustomed mode of living within the limits placed upon them by their medical advisers and they will have the benefit of English cooking and English hotels and apartments. Bath is within easy reach of London and other large towns, and thus the separation of members of families from each other (unless specially indicated) need not be complete or prolonged. The bathing establishments are open all the year round and can therefore be visited when many of the continental resorts are closed, but the periods regarded as the "seasons" at Bath are from September to Christmas and from the middle of January to the end of June.

The Mineral Water Hospital is referred to by our Sanitary Commissioner. The benefits of the thermal waters are chiefly open to the poor and "well-to-do." People with moderate incomes find Bath expensive and provision is needed for patients able to pay from £1 to 30*s.* a week. Nurses, however, and others who are entirely dependent upon their work for their livelihood and who are quite unable to pay for the baths can be treated gratuitously, through the generosity of the corporation, on the production of a medical certificate stating that they would derive benefit from the treatment and countersigned by a magistrate or councillor and the manager of the baths.

The beautiful scenery around Bath is too well known to need description here. The numbers of walks and drives around the city will supply the visitor with pleasing variety and the invigorating air of the hills is a useful adjunct to the course of baths.

THE MEDICINAL USE OF THE WATERS.

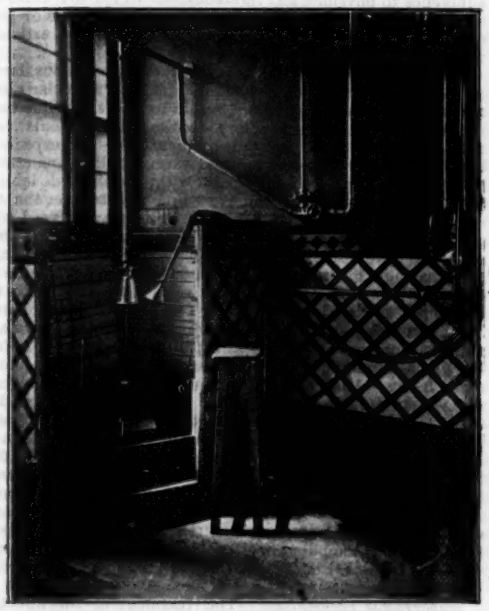
It is difficult to estimate the relative therapeutic values of drinking the waters and bathing in them, as the two methods are usually adopted simultaneously.

DRINKING THE WATERS.

When fresh the water is clear and sparkling, without odour, and with a very slight saline chalybeate taste which is by no means unpleasant. The quantity to be taken is, of course, regulated by the physician. As a rule from half a pint to one and a half pints are ordered daily and this should keep the bowels in regular action. In certain forms of disease the Bath waters have been found most useful when taken cold, especially in surgical urinary conditions. In cases of cystitis the results are most encouraging, and here it may be mentioned that the waters are artificially aerated and sold under the name of "Sulis water," which forms a palatable table water. Another peculiarity of the waters mentioned by one of the physicians which it is difficult to explain is that if patients are intolerant of iodide of potassium if this drug is dispensed in solid form and added to the water at the time of drinking larger doses can be taken and for a longer time than if prescribed in the ordinary way.

The action of the Bath waters when taken by the mouth has been deemed by most authorities to be simply due to drinking large quantities of hot water, so washing out the stomach and intestines and flushing the kidneys and producing a marked diuretic effect. The beneficial action thus brought about is most marked in cases of gout and chronic gastric affections, this natural lavage being more pleasant than the use of the stomach tube. In connexion with these remarks the experiments recorded in our analytical report as to the solvent action of the waters on uric acid are suggestive. The waters contain a very small amount of iron, in a very

FIG. 4.



The Local Spray Bath; for application to individual joints when the patient cannot be undressed.

assimilable form it is true, but it seems difficult to ascribe to this ingredient the benefit which anæmic patients undoubtedly derive from a course of treatment. It would seem more probable that the favourable result is to be ascribed to the regulation of the bowels, thus preventing the absorption of deleterious products due to detention of fæcal matter in the intestine.

DISEASES MOST FREQUENTLY TREATED.

Gout.—This disease occurring in widely-differing constitutions varies greatly in degree. Not every patient afflicted with the complaint will benefit by a visit to Bath, but the

majority will, and those individuals who have unsuccessfully tried other English and continental spas need not be discouraged on that account from trying a course of thermal waters at that place. Dr. Luff[1] points out that owing to the undoubted fact that sodium salts are directly detrimental to the removal of gouty deposits those springs should be avoided which owe their activity to those salts when the removal of the deposits is the main object to be attained. The springs which contain no sodium salts or traces only are the ones suitable for such cases. A reference to the analysis of the Bath waters will at once show that they would come under this category. A course of treatment, also, tends to remove or relieve various disorders which stand in a more or less close degree of causal relationship to gout, such as gastric irregularities, gastric and intestinal catarrh, acidity, constipation, portal congestion, and certain urinary disorders. In the intervals between the paroxysms much may be done in the way of massage and the use of the baths and local douches to remedy the inflammatory thickenings of the tissues and the consequent articular stiffness, contraction of tendons, &c. In gouty dyspepsia it is recommended that the waters should be sipped at a temperature of about 117° or higher, beginning with a small dose and rapidly increasing it. In the more chronic forms, besides the vapour baths, the deep and reclining baths, and the douches, the Aix massage bath is of great use, but much care must of course be exercised in applying massage. Patients must not be alarmed if the early part of the treatment precipitates an acute attack of gout. If such an event happens the use of the Bertholiet vapour bath has been found to give relief. One of the local physicians stated that he had found considerable relief to be afforded by the use of the throat-spray in gouty pharyngitis. Undoubtedly part of the explanation of the benefit derived by the gouty from a course of treatment at Bath lies in the careful dieting and general adherence to physiological righteousness which are enforced on them by their medical advisers. Irregular forms of gout are as satisfactorily treated as the ordinary articular variety.

Chronic rheumatism.—Treatment of all the various forms of so-called "chronic rheumatism" (chronic articular rheumatism, muscular rheumatism, senile arthritis, morbus coxæ senilis, &c.) yields satisfactory results, and patients convalescing from acute and subacute attacks are especially benefited. The waters are employed warm, locally or generally, either in the deep or reclining bath, with or without douching, when the patient is weak and as he becomes stronger the Aix massage, hot douching, and vapour baths may be used with massage and active and passive movements. The waters appear to have a soothing effect and greatly to alleviate pain. The massage given whilst in the bath has a powerful effect in lessening deformity and restoring pliability to the thickened and stiffened joints. The general vapour baths are also employed with success by causing perspiration and aiding absorption and the local vapour baths appear to soften the tissues around the joints and to enable them to be moved more freely. Muscular rheumatism, as a rule, will require the Aix massage douche, together with dry massage, and if these methods fail to give relief the Bertholiet vapour bath and the massage reclining bath may be tried. Patients must not be discouraged if no effect is produced after the first few baths; no satisfactory result is likely to ensue unless a course of from 12 to 15 baths be taken. The bath treatment is contra-indicated in acute rheumatism. As already pointed out, the general experience of the local practitioners is that cardiac complications are benefited by the natural thermal baths without recourse to artificial effervescing baths.

Gonorrhœal rheumatism.—The treatment of this affection has also yielded satisfactory results. The patients, being usually young male adults, stand the Aix douche and other baths well. Copious doses of the water are usually prescribed and a generous diet without stimulants is of importance.

Rheumatoid arthritis.—This disease is singularly refractory to treatment. The statistics of the Mineral Water Hospital show that only 5 per cent. of the cases are cured, but that 80·7 per cent. are relieved, a lower percentage than is found in the case of gout or rheumatism; but comparing these results with those in which the ordinary treatment is adopted the thermal waters of Bath hold out hope to those who have not tried them. The course of baths is of course most satisfactory in the early stages. The advanced cases will naturally bring discredit to any spa, and if no relief is obtained by them the disease, not the waters, must bear the blame. Before great disorganisation of a joint has taken place, however, considerable improvement is possible, pain is relieved, and movement is increased. Immersion in the deep bath is first employed, and then wet and dry douching, the latter, however, being used with much care. The value of the trained attendants is especially demonstrated in the treatment of this affection, the massage and shampooing combined frequently producing the best results. In the acute stages of rheumatoid arthritis the bath treatment is not suitable. The course is often a prolonged one and it is sometimes desirable that the baths should be suspended for a time, the patient, perhaps, leaving the city for a change, to return for further treatment.

Sciatica.—Great relief is often obtained from the deep baths with under-current douche. The local physicians speak with enthusiasm of their results. In the acute stages, however, the simple bath only can be borne.

Disorders of the digestive organs.—Dyspepsia, flatulence, and constipation are often much relieved, the result being partially due to washing out the stomach by drinking the waters, partially to the bathing combined with massage, and also to the dietetic regulations to which the patients have to submit. The enema baths are also frequently employed.

Anæmia.—This complaint has already been referred to when discussing the effects obtained by drinking the waters. In addition the tepid reclining bath with gentle massage is of advantage.

Syphilis.—Bath lays no special claim to the treatment of syphilitic conditions, but a course of baths is sometimes taken as an adjuvant to specific treatment, especially that of inunction. According to the experience of one of the physicians the baths, by promoting the action of the skin and the secretions generally, help the elimination of the drug and brace the system against its injurious effects. He has found that when the baths are taken during the administration of mercury the effect of its therapeutic action is increased. In the anæmia and prostration resulting from the long administration of the drug the waters will be found to act as an excellent tonic.

Diseases of the skin.—Psoriasis, eczema, acne, and some other diseases of the skin are successfully treated. If the condition happens to be of a rheumatic or gouty origin the results are very good. Reclining tepid baths are generally first employed, the temperature being gradually increased, as also is the time of stay in the bath. Vapour baths are finally given. Prolonged immersion has been carried out to a limited extent only. Sulphur and other medicated baths are also used.

Diseases of the nervous system.—Chorea, especially when associated with a rheumatic history, yields good results. The various forms of peripheral neuritis are also treated with advantage, as also are the after-results of hemiplegia and myelitis. Patients the subjects of tabes dorsalis also present themselves for treatment, and by the use of the reclining bath and the Bertholiet vapour bath at 90° or 92° with the gentle spinal spray the girdle and lightning pains are frequently considerably ameliorated. Cases of neurasthenia, too, improve under the use of massage and the stronger douches.

Diseases of the respiratory system.—The water is used in a pulverised form for chronic bronchitis, asthma, bronchiectasis, chronic laryngitis, and pharyngitis, but it is commonly held that the treatment is most successful in respiratory affections dependent upon the gouty constitution. Various medicaments can be added to the sprays if desired.

Diseases of women.—Various forms of these diseases yield satisfactory results, but the best are attained in interrupted or painful menstruation. The reclining baths are employed with local hot under-current douches to the sacrum and lumbar and ovarian regions, whilst the ascending hot douche is also of service. Cases of leucorrhœa and cervical catarrh and induration also experience benefit. Chronic inflammation of the ovaries is sometimes relieved by reclining baths and the under-current douches.

Results of injury.—Stiffness and pain as the results of injuries to joints are greatly relieved by the douches and massage.

Debility.—Convalescence from protracted disease or from

[1] Gout: Its Pathology and Treatment.

acute affections may be accelerated by a course of treatment at Bath. Malarial cachexia is also benefited by the Berthollet vapour baths but the explanation of this fact is obscure.

CONTRA-INDICATIONS.

It may be generally stated that the bath treatment should never be adopted in any disease during its acute stage. Tuberculous joint disease and pulmonary affections (with the exceptions already mentioned) derive harm rather than good. Patients suffering from any form of abscess or large open sores also are not suitable for treatment. Epilepsy is also debarred, not only on account of the risk of an attack occurring whilst the sufferer is in the bath, but because experience has shown that the frequency of the attacks is increased. Some forms of heart disease, as has already been intimated, improve under a course of baths, but when there is marked arterial sclerosis, advanced atheroma, aortic incompetency, or pronounced fatty degeneration of the heart the baths must be used with the greatest caution even if not altogether forbidden. Aneurysm of the aorta is also a direct contra-indication to their adoption.

THE SANITARY CONDITION OF BATH.

(BY A SPECIAL COMMISSIONER.)

THE DRAINAGE OF THE BATHS.

If we study the past history of Bath it must be confessed that the authorities governing the town have in the main failed to appreciate the true interests of its inhabitants. Certainly they have not availed themselves of their many and exceptional opportunities and in some instances they have neglected very obvious duties. Fortunately Bath may now be described as in a state of transition. There has been a general awakening. Manifest signs of improvement may be noticed in many directions. The baths are already equal to the best continental establishments of a similar character and in respect to general sanitation the town is now seeking to place itself on a level with the more progressive cities of England. This work, however, is not yet completed, though it is satisfactory to note that within the last two or three years it has been taken actively in hand. For instance, the drainage of the baths may now be considered to be in a satisfactory condition. Indeed, the water is now so well protected from contamination that several persons have complained that it has lost much of its time-honoured flavour and is no longer nasty enough to do them good. This is not surprising, for since the obliteration of the civilisation which the Romans had introduced into Bath and up to a very recent date no one seems to have thought it to be at all necessary to drain the baths. Nevertheless, a protest was made so far back as the time of Queen Elizabeth that the baths were not drained. There was an exit for the overflow which was supposed to have turned a mill but there were no means of cleaning out the baths. The water then ran in a southerly direction from the principal well. It does not seem that the complaints made during the reign of Elizabeth produced much effect, for it was not before the year 1882 or thereabouts that all the baths were systematically drained, and even then the water was only carried off to the level of the main sewer of the town. The drains which conveyed the bath mineral waters to the main sewer also drained the closets of the baths. Therefore, when these drains were accidentally blocked the waste water and the sewage flowed back into the springs. At the same time it was noticed that when patients were ordered to drink the mineral waters they not infrequently suffered from a sort of low fever. Under the circumstances this was not surprising and several medical men began to suspect contamination. But even when the drains were not accidentally stopped up they were on so high a level that very little was required to produce a backward flow.

The water for drinking was pumped out from below the grate of the King's Well. When the quantity extracted was small it came from the lower portion of the well and was at least comparatively clean, but when a larger quantity was required, then the water above—namely, the waste water from the baths—was drawn down into the well and pumped up. Hence small pieces of skin, nails, hair, and other fragments from the bathers were found in the water given to the patients for drinking purposes. Mr. William Smith, well known as "the father of geology," had tried to separate the water so that what was used for drinking should be absolutely pure, but he was not successful. It was not till Major Davis, the town architect, discovered the old Roman sewer that an effective remedy for this disgusting and disgraceful state of affairs was applied. This Roman sewer is at a much lower level than the town sewers. It is built with the solidity which distinguished the work of the ancient Romans and being still in a marvellous state of preservation it required but comparatively slight repairs to be utilised once more. The connexion between the baths and the town sewers was then completely severed. All the mineral water from the springs used for the baths now flows into the Roman sewer, which is at such a low level that there is no possibility of a back flow. Nor has this Roman sewer any connexion with the town sewers; it flows straight to the river and only receives the mineral waters from the baths. Further, it should be noted that those baths which are situated near to the springs are not provided with any closets, thus the danger of a drain-pipe breaking and contaminating the springs is obviated by the absence of any such drain-pipes. This very necessary disconnexion has, however, only been achieved within the last three years. It is certainly not creditable to former administrations that such obviously dangerous conditions should have been allowed to exist so long. Yet there are even to-day people who grumble because the baths are no longer drained into the town sewers. It appears that this alteration has increased the consumption of coal. The sewers charged with the hot water from the baths passed close to the walls of many basement kitchens. It helped to keep these kitchens warm and now the inhabitants complain of cold and say that they spend more money on fuel. Others, as already mentioned, have lost their faith in the waters because, being cleaner, they no longer have so pronounced a taste. It is difficult to please everybody.

THE SUPPLY OF MINERAL WATER.

As the volume of hot water from the baths and springs is very considerable there can be no doubt that it must have made a marked difference in the temperature of the sewers and of the houses abutting upon them. Yet the volume of water has been decreasing. According to ancient documents it amounted to 9,093,000 gallons in the year 1633 and the Cross Bath was originally the most abundant spring. In 1727 and even earlier this supply was much affected by buildings which were erected in the neighbourhood and ever since that time there has been a diminution of the supply. It was estimated at 6,295,600 gallons in 1748, which, it will be seen, is a great falling off from the previous figures. Some 60 years ago the springs were tapped at a considerable distance from the baths and this caused a further reduction in the supply. But there is a charter to prevent this and legal proceedings were taken and the tapping of the springs was stopped. Nevertheless, the yield of water in 1897 showed a falling off of another million gallons, the amount being only 5,279,270 gallons. It is probable that what has been lost might be recovered if the Corporation had the means or were willing to incur the necessary expense. For the present, however, this is not urgent. Other reforms and measures are more pressing. Besides, twice as much water is wasted at the baths as is utilised. There are probably not far short of a thousand different taps at the baths and there must be waste when there are so many deliveries. Indeed, it has been calculated that even including the cost of attendants, pumping, &c., the hot mineral water at the baths is sold at a lower rate than the ordinary drinking-water supplied to the town. But, on the other hand, the income has greatly increased of late. Now that the mineral water is protected from danger of contamination the amount drunk is five times greater than it was a few years ago and the annual income at the baths has increased from £1500 to £7000 or £8000. The single baths generally contain 780 gallons of the hot mineral water; the largest single baths hold 820 gallons. In the reclining baths there is an overflow contrivance, so that a current of fresh water can be provided all the time. This, again, leads to an enormous consumption of water.

THE VENTILATION OF THE BATHS.

With respect to the sanitation of the baths care has been taken to place each bath in a lofty room or compartment. At the top the windows can be opened with the aid of ropes and pulleys and a good through draught is thus established. Then as the walls are covered over

with tiles these can be thoroughly scoured with the aid of a hose. The atomising-room is very lofty, more than 20 feet in height, and has a domed roof. Here sprays, medicated or otherwise, are provided for the eye, throat, or ear, and the charge being only 1*s.* 1*d.* this department should be extensively patronised. The doors are made of walnut and ebony wood. There is no paint or glue employed for any of the fittings, so that no damage can be done by the heat or by steam. But the steam is readily dispersed, for with but one exception there is a dome or lantern over the raised walls or roof of the compartments where the baths are taken. There are, it is said, 40 different styles of baths available and it is a pity that a detailed list or catalogue of the various systems applied is not published. The medical practitioner on consulting such a description would know exactly what he could prescribe to his patients.

THE SEWERS OF BATH.

Bath, like most other towns, used to be drained into cesspools, but about the year 1711 a large well-built sewer in which a man could walk upright was constructed. In 1725 it seems that other sewers were made, for a large bronze head was found while digging the trenches. In 1727 the town was considerably enlarged, though it was then still enclosed by city walls surrounded by a wide moat which was full of water and which communicated with the river. The main street ran from north to south and parallel with its course there was a trench called Bumditch into which some closets were drained. There was a similar ditch following the road which went from east to west, or the London road. Thus what with these ditches and the early construction of sewers it is argued that there never were many cesspools in Bath. The ditches were cleansed more or less by the many springs and water-courses which came down from the neighbouring hills. The ditch running from north to south also received the waters from the baths and this formed a warm horsepond just outside the town. Queen Anne patronised Bath extensively and visited the town several times. This led to many improvements. The streets were widened and at the middle of the last century the town was much enlarged on the northern side. Fine squares were built by the famous architect Wood and at the same time big sewers were put in. The flow in most cases was from north to south, the greater part of the town gravitating in that direction. These sewers were built of the local stone and were arched, but the bottom was quite flat. There were consequently many deposits. On the other hand, if this contributed to pollute the sewer air most of the closets were fortunately placed outside the houses. They were of primitive construction. Under the seat there was a long trough slanting to one end where a plug was affixed over the mouth of the soil-pipe and had a handle protruding above the seat so that it could occasionally be lifted up. At the other extremity of the trough there was a water-tap. The trough might be filled with water and then the plug pulled up and the contents borne down the soil-pipe by the rush of the water. The authorities at Bath have inherited a greater legacy of old sewers than is the case in most towns. They have placed hardware pipe sewers inside these old and cumbrous structures and some of the latter have been filled up. To compensate for the smallness of the pipe as compared with the old large stone sewers storm overflows had to be provided together with special ventilation shafts. The old culverts which were considered perfect and are now condemned as insanitary will be utilised as storm overflows when the outfall is below the mean water-level of the river. Some of these ancient sewers are at a distance of more than 600 yards from the river. About eight years ago some men were injured in descending one of the sewers. This accident was attributed to the discharge of acids used in a factory. The Public Health Amendment Act gives powers for the enforcement of greater precautions. The manhole lids are removed and gratings are put in so that the air may rush out of the sewer for some time before men are allowed to go down. Nor are the men allowed to work for more than three days a week inside the sewers. Also the new Act enabled the authorities to prevent the discharge of sundry injurious substances into the sewers. But this has somewhat reduced the flow of the sewage. On the high levels there are about 30 shafts some 30 ft. high to ventilate the sewers, but there does not seem to be any systematic inlet. It is said that as men are constantly working in the sewers the manhole covers have then to be removed and this causes an inrush of air. As for substituting open grates for these covers the townspeople are represented as being too particular to have ventilators opening into the streets. These explanations, it must be admitted, are far from satisfactory. They clearly indicate that the sewers, or at least some of the sewers, are not self-cleansing. If they were self-cleansing it would not be necessary to have men constantly at work within them, nor would there be any objection to open grates on the street levels. But this is perhaps not the right moment to criticise the drainage of Bath, for the town is in a state of transition and it is not the fault of the town authorities if the works proposed have not been pressed forward more rapidly. A scheme has been prepared but the Local Government Board have made various objections, notably that the scheme is not complete. The contention between bacteriological and chemical methods of sewage purification has caused the present confusion. It is stated that the application of the septic tank system, such as is utilised at Exeter, would cost the town of Bath about £80,000 and that as there are no manufactories in Exeter the experiments made at that town are not sufficiently conclusive. On the other hand, the septic tank system has been tried at Yeovil, where there are factories, and there the results are not so favourable, but there, again, some very valid excuses have been made. The Town Council of Yeovil did not provide sufficient money to give the system a fair trial. The works were not complete, so that this trial is not considered to have settled the question. But if the members of the Town Council of Bath are not yet able to make up their minds as to how the sewage is to be treated before it is thrown into the river they want to begin at once the construction of the collecting mains which will bring the sewage to the outfall. Here they possess enough land to satisfy the Local Government Board should it be ultimately decided not to employ a septic tank or any other contrivance but to filter the sewage through the soil. The site has been purchased and paid for. It has cost about £11,000.

FLOODS AND RIVER POLLUTION.

In planning a general scheme for the drainage of Bath the question of floods had to be taken into consideration. The river does not, as a rule, overflow its banks at Bath but in flood times it occasionally forces its way up the sewers and drains and thus gains access to the houses. Therefore it is proposed to build two main collecting sewers on each bank of the river. The embankments also were to be, and indeed have been, improved, so that the risk of the water overflowing is reduced to a minimum. Actually the whole of the sewage of the city is discharged into the river in its crude condition. There is not one outfall only, but a number of outfalls exist all along the embankments. Though the river is thus polluted wholesale it is said that the water is not in a worse condition after passing through the town than it is before entering. Perhaps the aeration of the water in flowing over the weirs which are on a level with the town purifies it to some extent. It is now proposed that the two main collectors, which it is decided to build on either side of the town, should be connected by a syphon passing under the Avon on the south side of the river at some distance outside and to the west of the city. Here a pumping station will be established and the sewage forced through a 24-inch iron main on to the outfall station at Saltford. The total distance will be about four miles. There is a slight rise so as to deliver the sewage at a higher level and thus it can be filtered through the soil before it reaches the river. Where the sewers are at higher levels than the river there will be storm overflows into the river. To accomplish this work a period of about three years will be required, and it is urged that this part of the scheme should be taken in hand at once instead of waiting till the method of disposing of the sewage at the outfall has been decided upon. In the meanwhile the sewage continues to fall into the river in the very centre of the town. The numerous sewer mouths are exposed to view when the water is low; but, on the other hand, no bad odours are noticed and there has been no special incidence of disease along the course of the river. Of course, the closets which for the most part were outside have now been placed inside the houses and pipe-drains have been substituted for the old square Ashley stone drains. A great quantity of disinfectants used to be poured into the sewers. This has been stopped for it is as costly as it is useless. More careful scavenging and measures to prevent the throwing of rubbish into the river produced better results. It would also be more to the point to utilise the mineral waters to

deodorise the sewage. The hot springs yield, according to the calculation made by Dr. W. H. Symons, the medical officer of health, and discharge daily into the river as much ferrous carbonate as would be obtained from two hundredweight of ferrous sulphate or green copperas. Ferrous carbonate is one of the best chemical purifiers of sewage by virtue of its oxygen-carrying properties. The amount derived from the hot springs is just about the quantity needed to deodorise the sewage of the town, but to render its action efficacious it would be necessary to allow the mineral water to cool before it is mixed with the sewage. The ferrous carbonate which it contains is in solution with carbonic acid, that is to say in its most active condition as a carrier of oxygen.

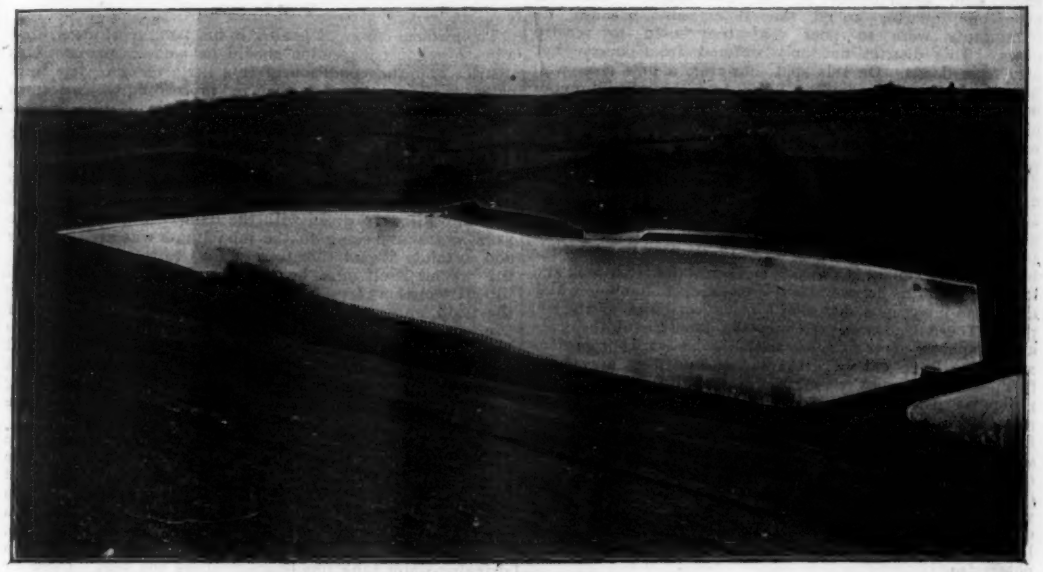
THE TOWN WATER-SUPPLY.

Some 30 years ago as many as 18 persons or companies were engaged in supplying water to the town of Bath. Some springs were owned by individuals who built rows of houses on their land and compelled the tenants to take their water, thus combining the letting of houses with the selling of water. In the years 1872–73 the Town Council began to take action against these water owners and companies. In seeking the aid of the Legislature they found that some of these companies, notably the Circus Company, were strong enough to resist in Parliament the efforts made by the Town Council. The powers of compulsory purchase were only obtained at a later date and in response to a requisition of a large and sufficient number of inhabitants. The Charlcombe Company was a still larger body and for a long time the Town Council could not supply water in their district as they were protected by a special Act of Parliament. The Town Council was ultimately obliged to buy up their rights and to pay dearly for them. In the parish of Bathwick the waterworks were under the late Duke of Cleveland and there again the town had no right to supply water. The Duke protested that he was not in a position to sell his claim outright and obtained instead a rentcharge of £670 less the taxes. The fact was that the water rents and not the works were of value. Many of these old springs which were the subject of proprietary rights are not now in use unless it be for flushing purposes, for they are situated too near to dwellings or are actually within the town. The reservoirs which used to contain the water of local springs now hold water coming from a much greater distance and from safer intakes. The smallest ones are not used at all.

The Corporation had commenced to construct waterworks in 1864, and began to wage war against the other water-supplies in 1872, but did not achieve the object of unifying the water-supply under municipal control till 1877.

The town now reckons on 1,400,000 gallons per day for 120 days as a minimum. This is secured by storage in reservoirs when the springs do not yield much water. During the rest of the year the water coming from the catchments equals, and very often exceeds, five or six times this amount. The water is delivered by gravitation, except in respect to 575 houses in two districts on exceptionally high levels. For these houses the water has to be pumped up to the highest reservoir at the Charlcombe Station. Still higher up near the Wesleyan College there is a spring and a small reservoir which except in dry weather suffice to supply the Royal School for Officers' Daughters, but in the dry season water also has to be pumped up to this reservoir. The latter is within half a mile of the principal cemetery; but the water has been analysed so frequently that if contamination could occur it is supposed that it would already have been detected. The flow from the cemetery seems to be towards the Lock's Brook in the valley below. But the question arises whether some persons living to the west and outside the city boundaries might not drink some of the water from this brook.

FIG. 5.



The Monkswood Reservoir.

What might be described as the middle zone is supplied by the Monkswood works, undertaken under the Act of 1870. Here a magnificent reservoir of 51,000,000 gallons capacity has been constructed (see Fig. 5). The mains from this reservoir follow the St. Catherine Brook. Headings with pipes are driven underground and convey the water direct into the main, so that it never sees the light till it reaches the town. But the water in the reservoir is, of course, exposed to the action of the light and the sun. The catchment area is chiefly pasture land and there are but very few scattered dwellings. The springs are at various depths and there are now no longer any surface springs, therefore if the ground were contaminated it would be difficult for such contamination to reach the water. The Monkswood reservoir is lined throughout with concrete slabs so that it may be easily cleaned out. The upper springs of the Bath supply are derived from the clays of the fuller's earth which are to be found beneath the Bath or great oolite. These springs are more superficial and therefore are affected by the rainfall. The lower springs are

thrown out from the upper lias or Milford sands and the supply is more constant.

The Batheaston or third supply provides the lowest zone and was constructed under the Act of 1846 by the municipality. The gathering grounds of this supply are in a valley some three and a half miles in length. The upper layer of earth consists of the Bath oolite, the rest is Milford sands. Altogether the consumption of water amounted last year to 21 gallons per day per head for all purposes. This is not a large quantity. The gathering grounds stretch over more than 100 acres which are considered as practically uninhabited though there are here and there a few cottages and on the gathering ground at Cherrywell there is a large farm. A few small plots of ground used for market gardening have been purchased by the municipality and the market gardens have been destroyed. The medical officer of health reports that the water is moderately hard and contains about 23 grains of solids per gallon; 16 grains of calcium carbonate; three grains of calcium or magnesium sulphates; about two grains of chlorine, and about one grain of nitric acid as nitrates, traces of silica, &c. The water is described as remarkably free from ammonia-producing and deoxidising substances, therefore it is maintained that Bath has an exceptionally good water-supply.

THE RE-HOUSING OF THE POOR.

Though Bath is a prosperous town and poverty is less prevalent there than in most other places of the same size, nevertheless it has its slums. There is even one quarter called the Dolemeads, because its inhabitants were so poor that they used to receive doles. This district not only suffered from poverty but also from floods. On this spot, however, a new river wall has been built at the cost of £8000 and this should render floods less frequent in the future. To build this wall 17 old houses were demolished and in their stead some model tenement houses have been built. Here two good rooms, a pantry, a sink, a closet with a waste-preventer flush, and the use of a washhouse can be obtained for 4*s.* a week. The washhouses, containing a copper, are situated on the basement. They measure 13 by 12 feet and are seven feet high. They are kept very clean, the floor is of concrete, and there is a ventilating shaft above the boiler. Each tenant has a coal bunk upstairs with lock and key. The drains communicate with an open manhole which acts as an intercepter and inlet for the ventilation of the soil pipe. There is no trap except at the junction of the drain and the public sewer. There are large backyards or gardens where the linen can be dried and the dustbins are at the farthest extremity away from the houses. The tenements in the upper portion of the building are divided into three rooms, the smallest having a capacity of about 600 cubic feet. Altogether 30 tenements replace the 17 cottages which were pulled down and they are all wonderfully bright, sweet, clean, and well kept. On the opposite side of the street and on the banks of the river there is an asphalted playground where swings, vaulting-bars, &c., are provided for the children. This attempt, successful so far as it goes, to re-house the working-classes has been carried out by private enterprise.

The Dolemeads district still contains, however, 211 houses rated at only £5 or less per annum and 108 houses at from £6 to £9. All these houses should be replaced by better structures built on raised ground to avoid damp and floods. Some schemes to this effect have been prepared. The first of these schemes deals with an area of three roods 26 perches, where it is proposed that the town should build 40 small houses with a frontage of 14 feet and an area of 280 square feet for garden or yard, to be let at weekly rentals of from 3*s.* to 4*s.* The ground also is to be raised nine inches above the height of the worst flood recorded. The total cost is set down at £10,500.

AN INSANITARY DAIRY.

One of the cottages which I visited in the Dolemeads district had a well and a closet in a washhouse. The closet was within five feet of the pump and could only be flushed by hand. Nor had the closet any window; it ventilated over the well. Crossing the garden in front to the washhouse of a similar house there was here also a well, but there was an upright pipe and tap close by from which the town water could be obtained. The closet was insufficiently ventilated and close to the pump. A test was applied to the drain and nothing noticed, but on going towards the street through a narrow passage which divided these two houses there was a small basement where a number of milk-cans were hung up. Close to the door inside this basement there was a gully, and here the odour of the test thrown into the drains was very perceptible. Originally the basement was a washhouse, but the front part had been walled off. This front portion is lighted by a grate above opening on to the street and by the side entrance door. Just behind this door there is a water-closet in good condition, but at the entrance of the closet there is a gully through which the odour of the drain-test escaped and immediately opposite the milkcans are hung up. This compartment is four feet four inches wide, but the larger portion of the basement, used as a washhouse and walled off, is dark, has no windows, and is only ventilated by the stairs which lead up to the dwelling-room above which is situated behind the little shop where the milk and other provisions are sold. The passage between the houses is 48 feet in length and 24 feet behind the entrance of the compartment where the milkcans are kept is the entrance to another house where there is an unventilated closet. The third closet, in the back garden beyond, into which the test had been thrown, is at a somewhat lower level and quite 70 feet away from the gully where the odour escaped. The little basement where milkcans are hung up in front of the dark unventilated washhouse and by the side of a mangle and a closet and over a gully through which the odour of the drain-test escaped was registered as a dairy some eight years ago and milk has been sold there for about 30 years.

THE SLUMS.

The medical officer of health in his last report urged that a house-to-house inspection should be made throughout this district and the condition of this little dairy clearly indicates the necessity for such a proceeding. The town authorities are well aware that the whole of this district must be dealt with, and I saw some stone cottages here, which have been condemned and are about to be pulled down, which for the solidity of their walls would do honour to many poor quarters of London. Some of the closets in this neighbourhood had no water-supply and several walls were green with the damp. But many of the worst cottages belong to the inhabitants who are very poor and certainly cannot themselves afford to rebuild. Besides, the ground itself must be raised and it is proposed to do this with clinkers from the town destructor. In some cases the flood water mixed with sewage reached to a height of five feet within these cottages and this happens about once in 10 years. After such floods it is very difficult to dry and clean the houses. The municipality does not at present propose to rebuild the entire district, but hopes by setting a good example to constitute a nucleus which will make the people dissatisfied who still remain in unwholesome houses.

On the other side of the river and in quite the opposite part of the town, on a high level and close to some of the most fashionable houses and streets, there is another bad district. Here also the Town Council is promoting a scheme for dealing with the evil, and the medical officer of health has condemned 41 houses containing about 200 inhabitants. In this district I found a closet in a dark scullery with a drinking-water tank immediately above the seat. Close by there was only one closet for two houses and there was one water-tap for 54 persons. There was real misery to be seen in this neighbourhood. The upper rooms were very low and damp. In one case there was but one window divided between two rooms, the paper was dropping off the walls and below the floor was on a level with the ground. There is considerable overcrowding and much squalor. It is necessary therefore that the scheme for rebuilding a part of this neighbourhood should be pressed forward energetically. Hen and Chicken-court which was a resort for vagrants and where fever prevailed has been altogether transformed and there is now a neat row of workshops. What has been accomplished in some instances and commenced in others might well be undertaken and carried through wherever needed and in all parts of the town. Though this may seem "a large order" there is less to be done in this respect in Bath than in most towns of a similar size. Also the poor in Bath are easier to deal with. They are not so degraded as the poor of manufacturing districts. Many of them have been domestic servants and have mixed largely with the educated and refined classes. As a result they are better mannered and they speak remarkably pure English with a very good accent. If such people are given proper houses to live in they are more likely to

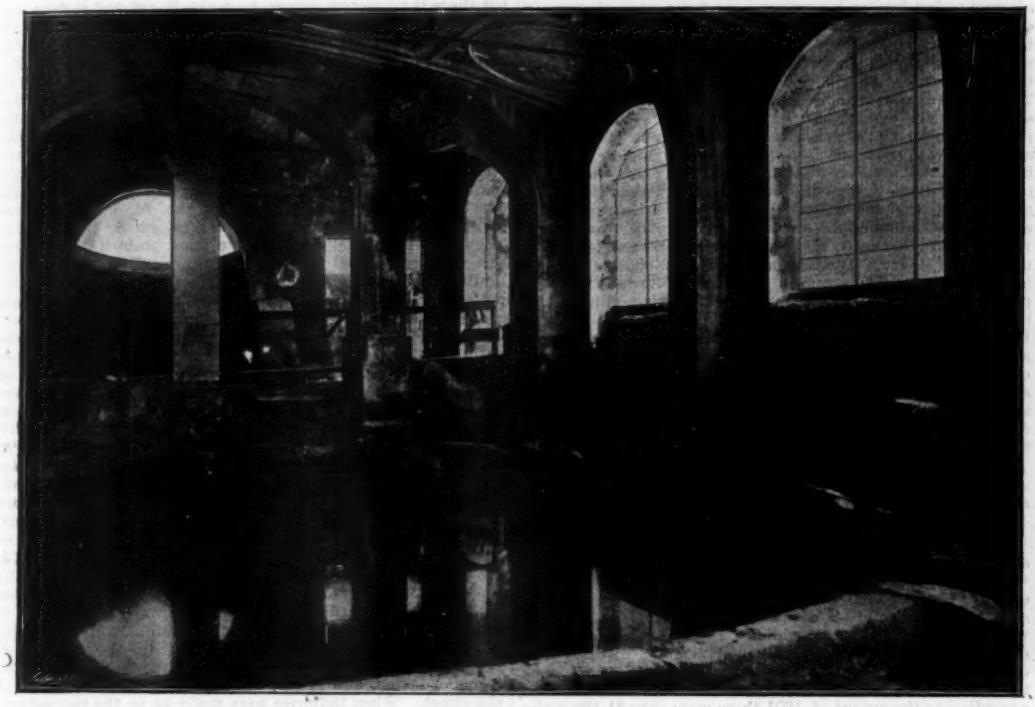
appreciate the advantage and to devote themselves to keeping their habitations clean and tidy.

DISINFECTION, DIPHTHERIA, AND HOUSE-TO-HOUSE INSPECTION.

With regard to general sanitary work, inspection of houses, disinfection, &c., there has been till within the last two or three years much culpable neglect. Even to-day the means of disinfection are anything but satisfactory. In his report for the year 1897 the medical officer of health states that the method of disinfection "at present adopted does not kill flies, spiders, or common parasites and is more expensive than disinfection by steam." This work instead of being undertaken by a competent public authority used to be done by a tradesman. At the time of my visit, however, a proper disinfecting station was being built by the side of the town destructor and a Washington Lyon's machine has been purchased. The next step is to provide a shelter where persons may sleep for a night or two while their houses are being disinfected. That private dwellings were not properly inspected is proved not only by the condition of the dairy in the Dolemeads district described above but also by an outbreak of diphtheria which occurred in the Larkhall district in 1897. A new assistant inspector of nuisances was then engaged who examined 333 houses. In 300 of these houses the drainage was defective and notices had to be served. This surely indicates how much this district had been neglected and yet only the grossest defects were noticed and no attempt was made to properly ventilate the drains. Nevertheless, this district is now one of the healthiest parts of the town, thus showing how much good can be done. There were open drains, no traps, and mere upright junctions. All this has now been remedied. 28 schools, for the most part very poor Church schools, were inspected. With but one exception they were all in a bad sanitary condition and alterations had to be effected. After this was done and during the whole of the following year, 1898, there had been no sickness in these schools. Taking the town as a whole there were 20 deaths registered from diphtheria in 1896, 16 in 1897, and only four in 1898. This suggests that a distinct improvement in sanitation has been effected so far at least as it seems to relate to this disease. Complaints are still made that at the Statutory or Isolation Hospital the precautions taken are not sufficient. There is a great need of smaller wards for the observation of doubtful cases, and the separation of convalescent from acute cases.

The medical officer of health, in his last report, draws attention to the fact that last year there was an exceptional number (37) of deaths from diarrhœa. Of these 29 were infants under a year old. Inquiries were made concerning 26 infants, and 10 had been fed on unboiled milk, six on boiled milk, four on condensed milk, three on milk and infants' food, and only three on mothers' milk. But of these last the father of one had died from acute Bright's disease at about the same time as the child died from diarrhœa and the mother of another child had had "milk fever." The third child had thrush as well as diarrhœa. Some of the dairies at Bath are far from being in a satisfactory condition. This brings up the whole question of food-supply. The death-rate from phthisis for males is above and that for females is below the average of English towns—a fact to be explained by the outgoing of males and the incoming of females between the ages of 15 and 35 years. The medical officer of health points out that female domestic servants constitute nearly one-eighth of the population of Bath and many of them when suffering from a chronic disease leave the city, while the young men who find employment elsewhere would in many instances return to Bath if unfit for work. This is all the more probable as the suitability of the climate of Bath for the treatment of pulmonary consumption has long been recognised. But daily evidence accumulates to show that for the prevention of tuberculosis great care should be observed in regard to the supply of milk and meat.

FIG. 6.



Old Roman Circular Bath.

SLAUGHTER-HOUSES.

There are now 32 registered private slaughter-houses in Bath. In 1877 there were 46, so that an improvement has

been also effected in this respect. The chief sanitary inspector, Mr. H. G. Montagu, has visited other towns so as to report on the question of public abattoirs. He recognises that it is a most difficult matter to deal with butchers. Their claims for compensation in the event of the construction of a public slaughter-house would be exorbitant. In the meanwhile, however, and pending a decision on this question, a great amount of diseased meat was seized a few years ago and convictions were obtained. This served as a salutary example and he does not think that much diseased meat now enters the town. But nevertheless it is absolutely impossible to inspect properly private slaughter-houses and the medical officer of health reports: "Did the public know the condition under which animals are kept and slaughtered and the meat stored for hours before being taken to the shops, it would not be long before the present methods were abandoned."

CORPORATION PROPERTY.

To contribute towards the expense of building public abattoirs and of carrying out other much needed reform the town has a source of revenue in its extensive corporate property. This has been most shamefully neglected and some of the houses which belong to the municipality have been allowed to fall into such a ruinous condition that they were condemned as unfit for habitation. On one occasion the working-class tenants of some of these houses had to organise a regular strike. They said that they had to walk ankle-deep in sludge to reach their houses. Their complaints remained unheeded, so finally they all simultaneously refused to pay their rents. This called public attention to the matter. But this is now past history and the new Corporation is awakening to a higher sense of its duties and responsibilities. Besides, this corporate property now only brings in about £8000, whereas if it were properly repaired and managed it might yield a revenue of about £30,000 annually. As another source of revenue the town has just purchased the electric light works and is putting in new machinery. The Corporation is now considering the installation of electric cars so as to enable visitors to reach more easily the higher and more bracing mountainous districts which surround Bath. In the town the thoroughfares are being laid with hard Australian wood pavements and we see signs of progress in all directions. The medical officer of health also has installed five meteorological stations and is taking active measures to get more accurate information than is at present available concerning the geological formations. These observations go to show that Bath is suited for a summer resort as well as for a winter health station. This is more particularly the case in the bracing and high surrounding districts, where the climate is very pleasant in summer.

HEALTH STATISTICS.

In respect to the general health of the town the returns show that the average annual death-rate from 1888 to 1897 was equal to 18·5 per 1000. The crude death-rate for 1898 was equal to 16·3 per 1000. The recorded death-rate, reduced to standard for age and sex distribution, was equal to 15·3 and when corrected for non-residents to 14·1 per 1000. The death-rate from the seven principal zymotic diseases was only 1·4 per 1000, but in dealing with these figures we must take into consideration the very remarkable fact that according to the census of 1891 there were only 21,125 males in Bath and no less than 30,719 females. Many of the latter are not born at Bath but come to reside there. A large proportion of the residents have come to the town in their prime, others in mature age. A very considerable section of the population are in easy circumstances, well lodged and fed, and receive every attention in sickness. Then, among the poorer classes, an exceptionally large number are domestic servants and they live a healthier life than if they were engaged working in factories, &c. All this helps materially to reduce the death-rate which, under the circumstances, was certainly too high, and though there is now a notable decrease in the mortality still there remains room for further improvement. Thus the average death-rate for the city and borough of Bath was 22·7 from 1866 to 1870; 22·7 from 1871 to 1880; 19·9 from 1881 to 1890; and 18·8 from 1891 to 1895. There will be a still greater reduction in the death-rate when the reforms now in hand are completed.

INSANITARY CONDITION OF THE MINERAL WATER HOSPITAL.

There is one reform urgently needed for which the Town Council can hardly be held responsible, though it may be compelled to interfere if the proper authorities do not take the matter in hand. The Royal Mineral Water Hospital is, when judged from the sanitary point of view, a disgrace to the town. This institution was first opened to patients in 1742. Its object is to provide for the relief and support of poor persons from any part of Great Britain and Ireland suffering from such complaints as are likely to be benefited by the Bath waters. In 1795 two additional wards were added and in 1857 adjoining premises were purchased and connected with the older building by means of a corridor and at the cost of £20,000 the hospital was much enlarged. A further addition of 15 beds was made in 1886, so that it now contains 102 beds for males and 70 for females. It is situated in the centre of the town, close to the hot-water springs. The necessity of being near to these springs creates a difficulty, for the space is wanting to secure ample air and light; nevertheless the hospital need not remain in its present deplorable condition. If the streets around are narrow, this only renders it all the more necessary to thoroughly ventilate the interior of the hospital, so that what air there is may circulate rapidly. Certainly there is a shaft running across the ceiling at the end of the wards which is supposed to draw off the foul air; but there is no motive power to make it act and it does not seem to have any effect. A big bath which will hold 12 persons standing is situated just outside one of the wards. The water in the bath is generally at about 96° to 100° F., but the water from the douche is at 110° F. Beyond there is a second compartment for massage. After the bathing the atmosphere in the wards becomes very thick. In the morning also the wards smell badly. They are very dark, especially in winter and in the women's ward. There are large cracks in the floor and big rafters across the ceilings forming numerous angles which cannot be properly cleaned out. Some wards contain four rows of beds but are divided down the middle so as to make two wards. Though a through draught can only be obtained by opening the windows placed in this central partition, a draught limited to these windows, while more unpleasant to the patients, cannot reach the angles and recesses. The urinals are out of order, blocked, and dripping on to a board floor, the liquid soaking into the wood. There is a row of closets within six feet of the men's day- and dining-room. A door leading to these closets remains wide open and the smell of the disinfectants used in them is very perceptible in the day-room. Another closet near four small rooms has no window and no lead on the floor by the urinal. The boards beneath are soiled. A lantern gives light from the roof. The 70 women patients have only two closets available during the night and the odour from these closets invades the dormitories. The women's ward is lower down, has four rows of beds divided down the centre by a partition in the same manner as in the case of the men's ward above, but the former has a much worse look-out. On one side is a dark, small, central yard or shaft; on the other side a very narrow lane separating the old from the newer building. At the bottom of this central yard which supplies the air to one side of the wards there is a closet, a huge dustbin, and a laundry where it is impossible to see even in the middle of the day. The kitchen and the larder face the laundry; the furnace, boiler, and engine are likewise below the level of the street. When inquiries were made as to the precautions taken in the event of fire a hose was found, but it was worn out and useless. There was another hose, but it was in a paper parcel which had never been unpacked. In this dark basement, where the dust, the refuse, the washhouse, the kitchen, and the larder are all in close proximity, there is no disinfection, no attempt at sanitation, but there is a very fine piece of Roman pavement. Also just outside the hospital walls there is a little plot of ground where some 150 patients were buried. Near the sitting-room of the medical staff there is an obnoxious urinal and the mortuary is immediately underneath this sitting-room.

The food provided for the patients is generally said to be sufficient in quantity but poor in quality and badly cooked. Under such circumstances it is not surprising to hear complaints of the prevalence of diarrhœa among the patients during the summer. There have also been numerous cases of sore-throat. The suspicious nature of this complaint is demonstrated by the fact that the patients generally recover when sent to one of the four little rooms called the Cambridge Ward which are situated on the very top of the building where there is plenty of air and light. Also these sore-throats are sometimes accompanied with a temperature

of 103° F. There was further a case of pyæmia; the patient died three days after the symptoms set in and cultures were obtained from the joints. This case commenced with a sore-throat. Septicæmic symptoms have often been noticed. Though attempts have been made to attribute these to rheumatism the fact remains that the patients have always improved when removed to more healthy quarters. The patients also sometimes contract pneumonia and pleurisy while at the hospital. Then there are complaints about the nursing staff. There are some good nurses, others are not so reliable, and they have far too many patients under their care; therefore, when there are several serious cases it is necessary to get outside help. The nurses sleep in little rooms next to the wards which are far from healthy. But there is no fault to be found with the bathing or with the massage. The masseuses are very skilful; yet there is no training school for massage at Bath and the nurses have to go to London for their lessons.

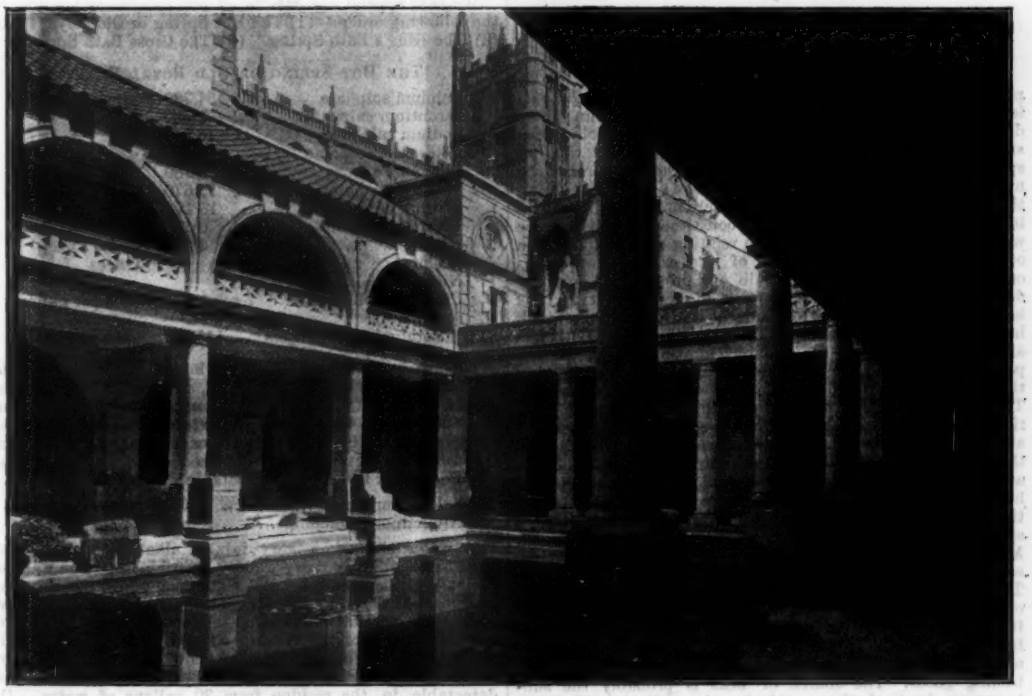
It is difficult to move the board of management to deal with all these evils because they do not depend upon local subscriptions. The patients come from all parts of Great Britain. Distant boards of guardians subscribe and they know nothing about the condition of the hospital. There are no medical men on the board of governors and when the members of the medical staff complain they are told that their only business is to attend to the patients and not to interfere with the management. A deposit of £3 has to be paid for each patient to cover the possible cost of a funeral and as there are always 150 patients the hospital has always £450 in hand which it can invest for interest. But a good many patients never reclaim the £3, especially if they are sent by their employers, masters, or mistresses. The accounts show a balance to the good and there seems to be no reason why more effective means should not be taken to improve the sanitation of this hospital. In its present condition it is a discredit to the town.

THE SOCIAL ATTRACTIONS.

As a health resort Bath has a wonderful historical record. Its reputation for its healing waters dates back to the early Britons and was established before the Roman invasion. As for the Romans, they seem to have appreciated the advantages of the hot springs far more than their successors did—a fact proved by the magnificent remains of the Roman baths (see Figs. 6 and 7). But to come to more modern times Bath won much of its popularity by the improvement of turnpike roads and the organisation of stage-coach travelling. The great Napoleonic wars also largely increased the number of visitors to the town. The wealthy in those troublous times had to content themselves with English health resorts. But with the reign of peace and the building of railways and steam passenger ships many of the patrons of Bath found greater attractions abroad. The managers of similar resorts on the continent have displayed far more skill in catering especially for the enjoyment of visitors. It must be confessed that Bath is a somewhat dull town. There are the attractions of society, private parties, dancing, and so forth for persons who have introductions, but what is the stranger to do who has no acquaintances in the town? There are beautiful walks and drives and there is much in the town especially of archæological interest. There is also an admirable technical institution for studious youths, but there is no casino, no general place of rendezvous. At the Pump Room there are a concert-room and a good band, but the people who go there have to sit as still as if they were in church. What is wanted is a winter garden, with restaurant, newspapers, café, &c., or club accommodation, and promenade concerts should be provided for those who like to walk about and talk without interfering with those who wish to listen. There must be some general resort where there is animation, where friends are certain to be met, and where the solitary visitor who has not yet made any friends will not feel his solitude.

This need is very generally admitted, but the hotel and restaurant keepers of the town fear that such a casino would deprive them of some of their custom. This is a narrow and false calculation, for they would be more than compensated by the extra number of visitors to Bath. The opposition of people who live at Bath on fixed incomes or pensions is more

FIG. 7.



Old Roman Bath.

serious. The catering for visitors would increase the taxes and the cost of living, while their incomes would remain stationary. Their personal interests are opposed to this phase of prosperity. On the other hand, it does not matter how high the taxes and the cost of living may become to the trading classes if the number and wealth of their customers increase in greater proportions. And thus the matter stands and it is difficult to say which of these conflicting elements will exercise the greater influence. There is also the Puritanic element which is very strong and is apt to consider many forms of amusement as likely to open the door to vice. In the meanwhile continental resorts continue to be more attractive than Bath. It will be something, however, if such sanitary improvements are effected as to render the town absolutely perfect from the health point of view. At all events the continental resorts might well be surpassed in this respect. Good sanitation is to the interest of all classes of the community and on this the public opinion of Bath should be absolutely unanimous.

THE CHEMISTRY OF THE THERMAL SPRINGS OF BATH.

(WITH ANALYSES FROM THE LANCET LABORATORY.)

The thermal springs of Bath are three in number. It is probable that they have a common origin, but the three outlets are perfectly distinct though they are within short distances of each other. The temperature of each varies slightly, but according to our own observations the hot spring which supplies the Old Royal Baths keeps nearer to the maximum—120° F.—than do the rest. The chemical composition of the waters is analogous, but there are some differences in the amount and ratio of the constituents of the three waters. The interesting question relating to the explanation of the formation and origin of the thermal waters is one with which it is hardly within our province to deal nor does it affect the general purport of this inquiry. It is interesting, however, just to glance at the speculations which have been offered on this point from time to time. Bath has afforded and still affords a happy hunting-ground for the palæontologist and geologist, every day almost witnessing the laying bare of fresh fossils and new geological evidences. The geology of Bath would appear to indicate that at some time in the history of the district a great volcanic convulsion and upheaval happened. This would account for the fact of the junction of two different geological formations in Bath, a fact which is invariably concurrent with the existence of hot springs. There is further evidence of some communication with marine sources judging from the beautiful specimens contained in the collection of Mr. J. W. Morris, F.L.S., who has made a special study of the sands, earths, and other substances deposited in the springs. The waters evidently course through long fissures and on their way probably come into contact with coal measures, for particles of coal are occasionally thrown up in the hot bubbling waters. This probably explains the occurrence of a small quantity of hydrocarbon gas which is found in the issuing gases. The source of heat is probably the subterranean heat of the earth's interior. At one time the waters may have been sulphuretted, but there is no evidence of this now, and further the gases contain an important amount of free oxygen. In this connexion it is interesting to note that we have found excessive quantities of sulphur in some of the deposits taken from the Roman conduits. In these iron was found with, in some cases, a large portion of free sulphur.

In the analyses which follow every precaution was taken to secure a sample of water which could be regarded fairly as representing that which was flowing into the baths. This step was attended with a little difficulty owing to the substructure of the baths, but this was removed by the assistance cordially afforded by the authorities and officials of the Bath Corporation. In the case of the Old King's Well, for example, operations could not be started until the bath had been emptied, the water welling over from a tube sunk in the centre. In the case of the Cross Bath a hole had to be cut in the stone floor of the bath in order to intercept a sample on its way from its natural outlet to the bath. In the case of the Royal or hot bath this was not possible, but an opening was made in the road outside, and thus the stream was tapped before it reached the bath. At the same time the opportunity was taken of observing the temperature.

In addition to making analyses in some detail of the Bath thermal waters in THE LANCET Laboratory a large quantity of the waters from the three springs was evaporated to dryness. About 30 gallons of the water were employed for this purpose and the operation was conducted in shallow pans on the spot. Thus several ounces of the salts of the Bath waters were obtained which enabled us to determine the presence, if any, of rare constituents. So far as we know and can gather the only analysis published of Bath water is that relating to the King's Well by Professor Attfield. Other investigators have analysed the same water but we have extended our analytical inquiries to the other springs, the Royal Bath and the Cross Bath. An instructive and interesting comparison of the composition of the three distinct springs may thus be made. In order to ascertain the nature of the gases evolved the Cross Spring seemed best suited for the purpose of collecting the gas. As regards the chief constituents of the evolved gases an approximate analysis was made on the spot. A further supply was taken for more detailed examination in THE LANCET Laboratory.

We next append the results of our laboratory analyses in the following order:—(1) The Hot Spring or Old Royal Bath. (2) The King's Bath Spring. (3) The Cross Bath Spring.

THE HOT SPRING OR OLD ROYAL BATH.

Calcium sulphate	84·720	grains per gallon.
Strontium sulphate	1·890	,, ,,
Sodium sulphate	15·670	,, ,,
Potassium sulphate	0·207	,, ,,
Calcium carbonate	8·750	,, ,,
Magnesium chloride	15·670	,, ,,
Sodium chloride	13·120	,, ,,
Lithium chloride	0·100	,, ,,
Silica	4·200	,, ,,
Bromine	Traces	
Nitrates	,,	
Carbonate of iron	1·030	grains per gallon.
Total mineral matters	145·557	,, ,,

This spring supplies the Old Royal Baths, the Tepid Swimming Bath, Bellott's Hospital, and the Hospital Baths, which are free to patients recommended by the profession. The temperature was 118° F., the external temperature of the air being 45°. There was no evidence of organic pollution, the following figures being obtained when the water was examined after the manner of potable waters:—

Saline ammonia	0·0112 grain per gallon.
Albuminoid ammonia	Nil.

The water showed a very faintly alkaline reaction and possessed a slightly "dry" and "hard" taste. The walls of the bath give evidence of the separation of iron, and it may be remarked that on this account the iron in the analytical results is probably somewhat under-estimated. Spectroscopic analysis of the residue showed lithium clearly and also strontium; their amounts are now placed on record, we believe, for the first time in this analysis. Bromine was just detectable in the residue from 30 gallons of water. On searching for evidences of arsenic none were gained, and no arsenic was found in a large quantity of the iron deposited. If arsenic were present it would probably occur in this deposit of iron.

THE KING'S BATH SPRING.

Calcium sulphate	102·880	grains per gallon.
Strontium sulphate	2·030	,, ,,
Sodium sulphate	23·500	,, ,,
Potassium sulphate	0·207	,, ,,
Calcium carbonate	8·750	,, ,,
Magnesium chloride	15·800	,, ,,
Sodium chloride	9·080	,, ,,
Lithium chloride	0·120	,, ,,
Silica	1·960	,, ,,
Bromine	Traces	
Nitrates	,,	
Carbonate of iron	1·600	grains per gallon.
Total mineral matters	165·927	,, ,,

This is the old historic bath spring from which probably the Romans derived their supply for the bath which has

recently been excavated and brought to light by Major Davis, the terraces and columns being in a beautiful state of preservation. The spring supplies the King's and Queen's Baths, the new Royal Baths, the swimming bath, the Kingston Baths, the drinking fountain in the Grand Pump Room, the Mineral Water Hospital, and the public fountain in Stall-street. The above analysis agrees fairly well with that published by Professor Attfield. There appears, however, to be a diminution in the amount of common salt, but the sulphate of soda as a constituent compensating for what constipating action the sulphate of lime may exert is in the same proportion. The analysis shows the amounts of two constituents not previously recorded—namely, sulphate of strontium and chloride of lithium. Gases gurgle through the water and it was here that Professor Dewar collected a large quantity from which by the process of liquefaction by freezing at the Royal Institution he succeeded in separating argon and helion. The former gas proved to be present to the extent of 140 parts per 10,000 and the latter in the proportion of 12 parts per 10,000. As already stated it was found inconvenient to collect the gases at this spring, the Cross Spring with which we deal next being selected for this purpose. The King's Spring is the most highly mineralised spring in Bath. The temperature of the water in the well was 114° F. As will be seen from the following figures there is no evidence of organic impurity:—

Saline ammonia	0·007 grain per gallon.
Albuminoid ammonia	0·0042 ,, ,,

The residue which was obtained on the evaporation of 30 gallons of the water yielded a minute quantity of bromine and afforded the usual spectroscopic evidence of strontium and lithium. No trace of arsenic was detected in the water or in the deposits.

THE CROSS BATH SPRING.

Calcium sulphate	86·360 grains per gallon.
Strontium sulphate	1·120 ,, ,,
Sodium sulphate	10·800 ,, ,,
Potassium sulphate	0·207 ,, ,,
Calcium carbonate	8·750 ,, ,,
Magnesium chloride	15·630 ,, ,,
Sodium chloride	13·150 ,, ,,
Lithium chloride	0·187 ,, ,,
Silica	2·100 ,, ,,
Bromine	Traces
Nitrates	,,
Carbonate of iron	1·870 grains per gallon.
Total mineral matters ...	140·174 ,, ,,

This spring is used to supply the free public bath. In this bath doubtless a great number of historic personages have immersed themselves. The spring rises at a depth of 15 feet below the flooring of the bath and the sample for analysis was obtained by boring a hole through this flooring. The temperature of the issuing water was 114° F., the temperature of the external air being 45° F. The water is in a chronic state of ebullition from the escape of gases. The bath is covered by a roof and the noise of the bubbling of gas is at times quite startling. It was here that samples of gas were taken and analysed approximately on the spot. The following were the results:—

ANALYSIS OF GASES (CROSS SPRING).

No. 1.

	Parts per 10,000.
Carbonic acid gas	320
Oxygen	213
Nitrogen with argon and helion	9,467
	10,000

No. 2.

Carbonic acid gas	160
Oxygen	160
Nitrogen with argon and helion	9,680
	10,000

No. 3.

Carbonic acid gas	256
Oxygen	170
Nitrogen with argon and helion	9,574
	10,000

No. 4.

Carbonic acid gas	395
Oxygen	457
Nitrogen with argon and helion	9,148
	10,000

Finally, a supply of gas was entrapped and brought to THE LANCET Laboratory for more detailed analysis. The results were as follows:—

Carbonic acid gas	220
Oxygen	120
Argon and helion	161
Nitrogen	9,499
	10,000

The argon and helion were obtained as a residue after "sparking" the gases in contact with potash. The spectroscopic features of both gases were well marked on passing the spark through a tube containing this gaseous residue after rarefaction by means of the mercury pump. No attempt was made to separate the argon from the helion. It is interesting to note that the combined amount of argon and helion in the gases of the Cross Spring found by our Commissioners agrees very closely with that found by Professor Dewar in the King's Bath Spring by means of liquefaction and freezing.

The quantity of mineral salts in the Cross Spring is decidedly below that of the other springs. In particular the sodium sulphate is comparatively small in amount, though the magnesium chloride, common salt, and carbonate of lime occur in similar quantity. Again, the Cross Spring showed rather more iron in solution. The examination of the residue from 30 gallons gave distinct indications by the spectroscope of strontium and lithium. Arsenic was not found in this residue or in the iron deposits. Bromine was again indicated. According to the following results there is no indication of organic pollution:—

Saline ammonia	0·0168 grain per gallon
Albuminoid ammonia ...	0·0056 ,, ,,

The water was clear and of a greenish hue, exhibiting a faintly alkaline reaction and possessing a peculiar taste.

In conclusion, the characteristic constituents of the thermal waters of Bath are the sulphates of the alkalies and alkaline earths together with the salts of magnesium and sodium. Thermal waters having the origin of their heat in the earth's interior occasionally contain boric acid. The hot waters in Tuscany are a case in point, that district on this account having been the centre of the production of boric acid on a commercial scale. The boric acid is supposed to be derived from boron nitride which in contact with water yields boric acid, nitrogen, and some ammonia. We failed to find the slightest evidence of boric acid in the Bath waters, although the disengagement of nitrogen gas suggests that it might be derived in a similar way. It is, of course, possible that borate of lime may occur in the deposited matters deep down in the spring. We could find no trace of copper in the water as reported by Sir Henry Roscoe though for this purpose we examined the salts from 30 gallons. The occurrence of argon and helion in the evolved gases is noteworthy. Neither gas is very soluble in water. Argon is soluble to the extent of four volumes per 100 volumes of water, so that it is about two and a half times as soluble as nitrogen and possesses approximately the same degree of solubility as oxygen. At the temperature of the Bath waters, therefore, the amount of argon, nitrogen, oxygen, carbonic acid, and helion dissolved can be only small. The thermal waters of Bath exert a distinct solvent action on uric acid. In our experiments, for example, it was shown that Bath water dissolved over five times the amount of uric acid that distilled water would similarly take up at blood heat—i.e., just under 100° F. Since the waters are drunk hot and used hot for bathing purposes this fact may have an important

relation to the therapeutics of Bath waters in the treatment of chronic gouty affections and rheumatism.

THE ANALYSES OF THE TOWN WATER-SUPPLIES.

The two chief sources of water-supply to Bath are, as has already been pointed out by our Sanitary Commissioner, at Batheaston and Monkswood. These conjoint supplies are quite adequate for the service of the city and it remains to make inquiry into the quality of the supply thus available. Accordingly our Laboratory Commissioners in association with our Sanitary Commissioner inspected the sources of supply and secured samples at both reservoirs as well as samples also of the water representing it in the condition in which it is delivered from the services in the city of Bath some miles away. The following are the results in grains per gallon:—

BATHEASTON WATER-SUPPLY.

	Water from the reservoir.	Water from the town main.
Free ammonia	0·0019	0·0010
Albuminoid ammonia	0·0010	0·0010
Nitrogen in nitrates	0·182	0·175
Nitrogen in nitrites	Nil	Nil
Chlorine in chlorides	1·12	1·15
Oxygen absorbed	Nil	Nil
Temporary hardness	7·81	8·06
Permanent ,,	12·19	11·20
Total ,,	20·00	19·26
Total solids	23·52	26·88
Phosphates	Nil	Nil
Behaviour on ignition of solids	Satisfactory	Satisfactory
Colour	Pale green	Pale green
Smell	None	None
Taste	Fresh and palatable	Fresh and palatable
Heavy metals	None	None

MONKSWOOD WATER-SUPPLY.

	Water from the reservoir.	Water from the town main.
Free ammonia	0·0028	0·0028
Albuminoid ammonia	0·0014	0·0014
Nitrogen in nitrates	0·161	0·175
Nitrogen in nitrites	Nil	Nil
Chlorine in chlorides	0·945	0·945
Oxygen absorbed	Nil	Nil
Temporary hardness	5·00	8·60
Permanent ,,	10·50	10·40
Total ,,	15·50	19·00
Total solids	20·72	24·08
Phosphates	Nil	Nil
Behaviour on ignition of solids	Satisfactory	Satisfactory
Colour	Pale green	Pale green
Smell	None	None
Taste	Fresh and palatable	Fresh and palatable
Heavy metals	None	None

These analyses present satisfactory features in conjunction with the results of the inspection of the sources of supply and their environment. There is little difference between the composition of the Batheaston supply and the Monkswood supply. Both are chalky and both give evidence of being free from any impurity organised or unorganised; indeed, the character of the water-supply of Bath is excellent. It is not only abundant but of admirable purity. The analyses show slight and negligible differences between the water obtained direct from the reservoirs and from the city service main, differences which are only due to a slight variation in the mineral matters which is easily explicable. The important deduction, however, to be drawn from these comparative analyses is that the system of service supply is free from reproach and that the pure waters at the reservoirs are delivered unchanged and in excellent quality to the consumer.

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